

**OHIO RIVER ISLANDS NWR DIVE TEAM
DIVING SAFETY PLAN
FRESHWATER MUSSEL SURVEYS, COLLECTING, STOCKING**

Background

The refuge is charged with specific goals and objectives regarding native freshwater mussels:

1. Continue baseline surveys of new acquisitions and monitor populations of native mollusks every five years;
2. Track the status of zebra mussels and their impact on native freshwater mussels at ten sites;
3. In coordination with state agencies, re-introduce fish and mussel species which have been extirpated from the refuge.

In addition, the refuge lends its diving support capability to aquatic ecosystem projects throughout the Ohio River basin, including collection and captive propagation of endangered mollusk species, salvage of mussels in harm's way, assessment of potential damages from spills or discharges, and re-introduction of endangered mussels into their historic range. Diving is an important and necessary management tool to accomplish the refuge's mussel objectives.

Objectives

SCUBA diving (using qualitative and quantitative methods) is used to inventory/monitor a particular site for population or community level parameters, such as relative abundance of species, density of individuals, biomass, and recruitment of juveniles; collect animals for research and management activities; and stock adult and juvenile mussels for restoration activities.

Description of Equipment and Techniques - Qualitative

Line transects (horizontal) of needed length are deployed in the water using weighted anchor plates at the ends, and buoy lines (vertical) running from the anchor plates to the surface, connected to ball buoys. The buoys serve to mark the transect from the surface, serves as an attachment point for the support vessel, and allow the divers to stage at the surface before descending and after surfacing.

In shallow (< 10' deep) waters where no other boat traffic occurs, or divers are protected by a surface boat and team, buddy teams may conduct qualitative surveys or targeted collecting without transects and buoys. Divers must stay in pairs and descend and surface together. A "tender" must stay above water and follow the team's progress from shore or small boat.

Divers enter the water from the support vessel or by swimming from shore to the starting buoy line. The support vessel will stay anchored at or near the transect line to drop off, tend, and/or pick up the divers. The divers then descend the buoy line at one terminus, and work their way along the bottom transect line as a pair, one on each side of the line. Divers may collect animals and place them in mesh bags for transport to the surface, or may collect all needed data underwater by writing on slates. If visibility is good (>3 feet), divers may move off the line collecting animals or data, always staying within view of the line. Each diver will place his/her bag or carabineer marker on the line at the point he/she moved off, coming back to that point before moving up the transect so the buddy divers will know each

other's location at all times. The tender boat will monitor the progress of the divers by the location of their bubbles.

After a transect is completed, the divers surface at the far buoy line, and the support vessel either moves to pick them up or, if conditions are safe, they may swim downstream along the surface to meet the anchored vessel. If carrying bags of mussels, the divers will not overfill the bags such that it is difficult to ascend with or carry the bag at the surface with the BCD inflated. The BCD will not be used as a lift bag. If the bag is too heavy, the diver will secure the bag on the bottom and attach a float buoy so that the support vessel can pull it up. Divers will prepare to surface when air supply reaches 800 PSI, and be back on the boat or onshore with at least 500 PSI.

Description of Equipment and Techniques – Quantitative

Sampling using quantitative methods requires the divers to excavate multiple samples of the same size from a random set of locations within a site. For sampling using quantitative methods, the team will first establish a grid of sufficient size (e.g., 80 m by 80 m) to collect an adequate number of 0.25m² samples to estimate the parameters needed. The number of samples and distance between samples will be determined ahead of time. The top and bottom transect line (upstream and downstream limits of the grid) will be set by boat or wading, with marks or loops at every 1-meter interval, and numbered flagging at every 5 and 10 meters. There are anchors and vertical buoys at the endpoints, and occasional anchors along the line to keep it in place. The team will also place perpendicular reference lines that run upstream/downstream at regular intervals so the divers can navigate along them to specified random points for sampling.

In shallow (< 5' deep) non-navigable waters where no other boat traffic occurs, buddy teams may conduct quantitative surveys without buoys or boat support provided there is one person standing by to receive samples.

Divers enter the water from the support vessel or by swimming from shore to the starting buoy line (usually the downstream line). The support vessel will stay anchored or idling downstream of the working divers to tend, and pick up the divers as well as receive samples from the divers while they work underwater. The divers then descend the buoy line, carrying a quadrat frame, scoop if needed, and mesh bags to collect samples in.

At the bottom, the divers move to their first sampling location (by x,y coordinates) and place the quadrat in the proper coordinate using the reference line and distance left or right of the line. If the visibility is poor (< 3'), the diver may use a "cheater rope" to connect the quadrat frame back to the reference line and follow that line back after the sample is collected. For example, if the sample for that data set is always 2 meters left of the reference line, the diver will connect a 2-m line to his or her frame, and connect it via carabineer at the reference line and move the frame left the 2-m length.

The divers may collect any mussels already visible on the surface and then excavate the substrate within the quadrat frame down to a depth of approximately 4", scooping all the material and mussels into the mesh bags. After digging, and if visibility permits, the divers will visually survey the frame area to see if any mussels remain within, and place them in the bag as well. Then the diver transports the filled bag back to the reference line. If the bag is too full to maneuver to the next sampling location, the diver will connect it to a pop-up buoy and send the buoy to the surface for pick up by the topside team later. The diver then moves to the next sampling location. The process is then repeated until the target number of

samples is collected along that line, and then moves to the next series of samples along another reference line, or until one of the divers reaches 800 PSI. The buddy team will then prepare to ascend and surface with at least 500 PSI.

The various sets of lines (vertical buoy line, transect lines, reference lines, pop-up buoys) present a potential entanglement hazard to the divers. They must become familiar with the sampling equipment configuration, keep personal dive gear streamlined to the body, hover just above the matrix of bottom lines and stay clear of the vertical lines when samples are being pulled up. Prior to the first dive, if one or more of the divers is unfamiliar with the configuration, the lines should be laid out on the ground so that divers can see the set-up, understand their use and potential for entanglement. Also, when excavating substrate, visibility may decline rapidly, creating low or no visibility conditions. If this happens, divers should maintain physical contact with the transect line or reference line via the cheater rope to their sampling frame, know where his/her buddy diver is, and become familiar with the sampling equipment configuration by feel. It is sometimes possible to see better by just rising up off the bottom two to three feet, above the silt plume. The divers must also increase their buddy checks (i.e., by squeezing the buddy's arm prior to moving out of reach and indicate direction along the line), since they may be separated for brief periods of time.

There are alternate methods of taking quantitative mussel samples where the whole substrate is not needed, but only the mussels. In this situation, a horizontal reference line will still be set on the bottom to aid the divers in navigating. The divers will still use quadrat frames and scoops, but may remove all large rocks and cobble first from the sample area. They then excavate the rest of the frame area and sieve the material while underwater, through a screen, placing all mussels found in a small mesh bag, one for each sample. The divers can carry multiple small bags inside a larger bag, move to new sample locations, and not return samples to the boat until the target number of samples is collected or one diver reaches 800 PSI.

Equipment list:

- transect lines with brass swivel boat snaps at ends to attach to anchor plates (may be marked off in increments for a particular survey technique and/or diver progress indicator)
- anchor plates with D-ring tops
- various length buoy lines with brass swivel boat snap clips at one end to attach to anchor plates and the open line end to tie to ball buoy
- 2 ball type buoys for each transect line
- quadrat frames
- mesh bags with string or clip closure
- pop-up buoys
- underwater writable slates and pencils
- support vessel large enough to move divers and their gear to and from survey location
- emergency oxygen kit
- first aid kit
- surface-to-diver communication
- dive flags (alpha and diver down)
- marine band radio and cellular phone (using best service available)
- daily Dive Float Plan
- personal dive gear per 241 FW 10 and spares

- tanks
- weights
- underwater lights
- camera equipment (where needed)

Diving Plan Hazard Analysis

The diving environment of large navigable rivers in which the dive team typically works (Ohio River primarily, but also the Allegheny River, Kanawha River, etc.) is described by the following conditions: water temperature, water clarity, water velocity, surface conditions, bottom types, debris hazards, and watercraft traffic hazards. Although the following discussion deals with the Ohio River in a general sense, site-specific information will be incorporated into each Dive/Float Plan prior to commencement of each diving operation.

Water temperatures on the Ohio River range from ~ 34 to ~90 degrees Fahrenheit. Generally, water temperatures in the river fall to the mid-40s by late November and do not reach 60+ degrees until sometime in May.

Water clarity on the Ohio River is affected by many factors. Generally, visibility is less than ten feet due to the high suspended sediment load, dense algae and plankton in the Ohio River. However, zero visibility conditions are not uncommon, especially after the substrate has been disturbed and/or at depths greater than 20 feet. Poor land use practices in certain watersheds leads to increased turbidity after heavy run-off events as well.

The water velocities observed on the Ohio River are also quite variable. Water velocity does increase after heavy rainfall or snowmelt (~2-4 knots), but these events are normally seen during the winter months. Normal river velocities are very slow (<1 knot) and are quite manageable as far as diving is considered, especially during the summer and fall months.

The surface conditions on the Ohio River are primarily affected by two factors – wind and watercraft wake. Winds can produce 3-5 foot waves and make diving operations very unsafe. If winds are producing more than 1-2 foot waves, the act of divers boarding and leaving the watercraft becomes hazardous, and it is difficult for the tender to observe diver bubbles (processing samples onboard the boat also becomes hazardous). Passing watercraft wake can be managed and usually avoided through the use of buoys, talking to barge tow captains, and running interference boats.

Substrate types and associated debris should also be considered, especially due to the limited visibility in the Ohio River. Submerged trees, drums, tires, metal, and other large objects are sometimes found on the river bottom. Bumping into or getting snagged on underwater debris is a possibility. Floating debris can be encountered on the river as well, usually tree limbs or other wooden items. These can be hazardous and should be considered. By avoiding diving during high flow periods, using the buddy system, and having the proper equipment, we can manage these hazards effectively.

Commercial and recreational watercraft traffic also constitutes part of the diving environment. The hazards associated with watercraft include their wake and possible collisions with divers. Large commercial tug boats and their barges are a special consideration. They produce large waves, are limited in maneuverability, and take up a large share of the river when they move through. However,

the hazards associated with watercraft can be managed through the use of buoys, dive flags, interference boats, and radio communications.

The diving environment in the Ohio River poses its own unique set of challenges. However, by identifying and properly managing these conditions, diving can be accomplished safely. The following section contains Refuge-specific policies instituted to insure that these “big river” factors are accounted for and safety is the first consideration during all Refuge diving activities.

| Hazard | Preventive Action |
|--|--|
| Water temperature | Proper protective suits (1/8", 1/4", or dry suit as needed) |
| Low visibility | Tight buddy system, staying on transect line, familiarity with equipment, hovering off bottom |
| Waves and wakes | Manage passing watercraft, avoid diving when waves > 1 foot continuously |
| Commercial and recreational watercraft | Communicate with commercial tow captains on radio, use required buoys and dive flags, intercept recreational boats with another boat |
| Debris in river | Avoid diving when velocities exceed 1.5 knots or water is above ordinary high water, tight buddy system, keep equipment streamlined, have proper equipment |
| Water quality | Consult EPA notices of bacterial exceedance and spill reports; use antiseptic ear drops after last dive of the day |

Refuge-Specific Diving Policies

- A. All Refuge diving will involve at least two certified divers, and one “tender” who will remain topside on the dive boat. The tender does not have to be a certified diver, but will be oriented as to what is expected of him/her.
- B. An emergency use “pony” bottle and regulator will be assembled and available on the tender boat, and if the tender is dive certified, then a set of mask, fins, and snorkel will also be on the boat.
- C. Appropriate buoys, markers, and dive flags will be deployed during all Refuge diving operations. When working in navigable waters, the support vessel will fly the blue-and-white “alpha” flag in addition to the red-and-white “diver down” flag.
- D. Depending on local conditions and sight distance, a second boat and operator will be available to “run interference” on recreational watercraft during all diving operations.
- E. Marine radio and telephone communication capability will be available during all diving operations.

- F. All commercial barge traffic approaching the dive area will be contacted by marine radio-telephone to inform them of the ongoing dive operation. This will provide the operator of the barge the advance notice necessary in order to give a wide berth and power down upon passing the dive area.
- G. All DOI/FWS watercraft policies will be strictly adhered to during diving operations.
- H. Diving operations will be prohibited while any of the following conditions exist on the river:
1. Waves exceeding 1' are continuous.
 2. Thunderstorms/electrical storms are producing lightning.
 3. The river stage is above the "ordinary high water elevation." This results in water velocities in excess of 1.5 knots and generally unsafe diving conditions. These elevations are listed on COE Navigation Charts and current river levels are available from the COE navigation dams.
- I. A combined Dive/Float Plan will be prepared for each dive prior to commencement of any diving activities.
- J. A property maintained and ready-to-use first aid kit and emergency oxygen administration kit is required at the dive site. Diving staff and field support crew are required to be properly trained in its use.

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